

REMARKS

Claims 1 through 13 remain pending. In response to the non-final Office Action dated May 17, 2006, claims 1 and 11 have been amended. Care has been taken to avoid insertion of new matter. A petition for three month extension of the period for response, with appropriate fee charge authorization, is filed herewith. Favorable reconsideration of the application is respectfully solicited.

Claims 1 and 11 have been rejected under the first paragraph of 35 U.S.C. § 112, purportedly for reciting subject matter that lacks support in the original disclosure, specifically the claimed phrase “a second reference voltage which is produced on the basis of a potential at the emitter of said power semiconductor device and set to be lower than a line power voltage.” The rejection is respectfully traversed. Claims 1 and 11, as presented prior to Office Action, are clearly readable, for example, on Figs. 1 and 3 of the original drawings. Claims 1 and 11 are amended herein to further clarify circuit relationship, as recited in the following excerpt:

a second comparator which detects a gate voltage of said power semiconductor device to output a second detection signal, when the detected gate signal exceeds a second reference voltage which is set, relative to the potential at the emitter of said power semiconductor device, to be lower than a line power voltage of a drive circuit for outputting a drive signal that drives said power semiconductor device and higher than a terraced voltage of the power semiconductor device.

This claimed recitation is readable on Fig. 1, for example, as follows. The second comparator (COMP2) has one input that receives the gate voltage at IGBT 1 (the detected signal). The second reference voltage V2 is set with respect to ground. The emitter of IGBT 1 is directly connected to ground. Ground voltage is lower than the Vcc line power voltage, which is applied to the drive circuit. Withdrawal of the rejection is respectfully solicited.

Claims 1, 3, 9 and 10 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Kimura, of record, in view of U.S. patent 6,180,966 (Kohno). Kohno has been relied upon only for disclosing a trench type semiconductor device.

Dependent claims 2 and 4 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Kimura in view of Kohno and Marquardt, of record. Marquardt has been relied upon only for elements recited in the dependent claims.

Dependent claims 5 through 8 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Kimura in view of Kohno and Horowitz, of record. Horowitz has been relied upon only for the additional requirements of the dependent claims.

Claims 11 through 13 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Wacknov, of record, in view of Kimura and Kohno.

All of the above rejections are respectfully traversed.

All claims require first and second comparators wherein the gate voltage of the power semiconductor device is compared with the first reference voltage and the collector voltage is compared with the second reference voltage, respectively, at the first and second comparators. When both of the gate and collector voltages exceed the first and second reference voltages, respectively, the protection signal is generated. Since two different comparators and two different reference voltages are provided, the protection of the semiconductor device can be securely made without a false detection of a short circuit state. None of the applied references teaches these claimed requirements.

Kimura, which has been relied upon in the Office Action for disclosing the above-described claim features, is a prior art document referred in the section of Background of the Invention of the original specification. Kimura discloses a circuit which detects a short-circuit

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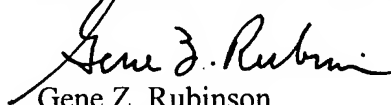
when the collector and gate voltages of IGBT are in "HIGH" state. As described in the present specification, the short-circuit detection method disclosed in Kimura can produce a problem. If a line power voltage is set as a reference voltage to determine a short circuit in the gate voltage of a device which has a low threshold voltage, or has a large current gain, such as a trench IGBT, when a short circuit is detected, the gate voltage is in a state where a line power voltage of a gate drive circuit, for example 15V, has been applied thereto. As a result, a short circuit current flows that is several tens times the device rated current.

The claimed invention overcomes such problems, as the reference voltage for the gate detection is set at a voltage (ground), which is lower than the line power voltage applied to the drive circuit. As none of the applied references teaches this claimed requirement, obviousness under 35 U.S.C. § 103 cannot be established.

Accordingly, withdrawal of all rejections and allowance of the application are respectfully solicited. To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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Date: November 17, 2006

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